United States
Department of
Agriculture

Forest Service

**Intermountain
Research Station**

General Technical
Report INT-254

January 1989

Microcomputer Software System for Generating Population Statistics From Electrofishing Data—User's Guide for MicroFish 3.0

John S. Van Deventer
William S. Platts

ORS

JOHN S. VAN DEVENTER is a computer scientist for the Riparian-Stream Ecology and Management Project of the Intermountain Research Station located at the Forestry Sciences Laboratory in Boise, ID. He received a B.S. degree in fisheries biology and M.S. degrees in natural resource management (specializing in statistics and information systems) from Humboldt State University. He is completing a Ph.D. degree in wildlife at the University of Idaho, with an emphasis in computer science and applied statistics. Previously he worked in data processing as a senior systems analyst for the Boise Cascade Corporation and for the Corporate Information Systems Division of the Morrison-Knudsen Company, Inc.

WILLIAM S. PLATTS (retired) was a research fishery biologist for the Intermountain Research Station located at the Forestry Sciences Laboratory in Boise, ID. He received a B.S. degree in conservation education from Idaho State University and M.S. and Ph.D. degrees in fisheries from Utah State University. He previously worked as a regional fishery biologist and supervisor in law enforcement with the Idaho Fish and Game Department, as an Idaho zone fishery biologist for the U.S. Forest Service, and as a consultant to the Surface Environment and Mining (SEAM) program. He has been in his present position since 1976.

COPYING INFORMATION

MicroFish 3.0 is available from the American Fisheries Society Computer Users Section. The cost is $6 if you send a disk, $10 if you don't send a disk. Disks sent must be 5¼-inch and double-sided, double-density. Disks should be labeled with the sender's name and address and should be protected with cardboard or a disk mailer to prevent shipping damage. Contact:

Anthony Frank, Librarian
USFWS Great Lakes Fishery Lab
1451 Green Road
Ann Arbor, MI 48105
(313) 994-3331

Once you obtain **MicroFish**, you may distribute the software to other users only under the following conditions:

1. The American Fisheries Society Computer Users Section (or the authors) must be provided the names and addresses of new users so update notices can be distributed.
2. The software must not be modified in any way.
3. A copy of this user's guide must accompany the software.
4. **MicroFish** must be distributed free of charge.

For questions concerning this application, you may contact the author at the following address:

Forestry Sciences Laboratory
Intermountain Research Station
USDA Forest Service
316 E. Myrtle Street
Boise, ID 83702
(208) 334-1457

The use of trade or firm names in this publication is for reader information and does not imply endorsement by the U.S.Department of Agriculture of any product or service.

Intermountain Research Station
324 25th Street
Ogden, UT 84401

CONTENTS

Microcomputer Software System for Generating Population Statistics From Electrofishing Data—User's Guide for MicroFish 3.0

John S. Van Deventer
William S. Platts

INTRODUCTION

MicroFish is a computer software system that processes electrofishing data obtained by the removal method. **MicroFish** consists of programs written in the BASIC language (compiled using MicroSoft QuickBASIC 3.0) and is functional on all IBM personal computers and compatibles using DOS 2.0 or higher. **MicroFish** was introduced as the Fisheries Population and Statistical Package (FPSP) (Van Deventer and Platts 1985). The software includes:

MicroFish Interactive Program—This program (MF.EXE) calculates maximum-likelihood population estimates based on user input of fish capture data.

MicroFish Statistical Package (Output: Table Format)—This package of subprograms (MFISH.EXE) calculates maximum-likelihood estimates and a series of fisheries statistics including capture probabilities, lengths, weights, and biomass.

MicroFish Statistical Package (Output: Database Format)—Performs the same calculations as the preceding package, except that output is in database format instead of table form.

MicroFish Sample Size Program (2-Dimensions)—The two-dimensional graph displayed by this program (MF-SS2D.EXE) indicates the number of electrofishing passes needed to achieve a desired level of precision. Computer graphics capabilities are required.

MicroFish Sample Size Program (3-Dimensions)—The three-dimensional graph displayed by this program (MF-SS3D.EXE) provides a conceptual foundation for the interrelationships among population size, catchability, electrofishing passes, and precision. Computer graphics capabilities are required.

Examples of output for programs MF.EXE, MFISH.EXE, MFISH-DB.EXE, MF-SS2D.EXE, and MF-SS3D.EXE are shown in appendixes 1, 2, 3, 5, and 6.

MicroFish System Files—The following files are included on the **MicroFish** diskette:

MF .EXE—the **MicroFish Interactive Program.**
MFISH .EXE—the **MicroFish Statistical Package (Output: Table Format).**
MFISH-DB .EXE—the **MicroFish Statistical Package (Output: Database Format).**
MF-SYS .EXE—a file required by **MicroFish** (of no concern to the user).
MF-SYSDB .EXE—a file required by **MicroFish** (of no concern to the user).

MF-SS2D .EXE—the **MicroFish Sample Size Program (2-Dimensions).**
MF-SS3D .EXE—the **MicroFish Sample Size Program (3-Dimensions).**
MF-SS2D .FIL—calculation information (input parameters) for MF-SS2D.EXE.
MF-SS3D .FIL—calculation information (input parameters) for MF-SS3D.EXE.

MF-TEST .DAT—a sample file of fish capture data.
MF-FISH .DAT—a list of fish names and associated numeric codes.
MF-PARM .DAT—a file of parameters that enhance program operation.

BRUN30 .EXE—the compiler runtime module (of no concern to the user).

INSTALLING MICROFISH

This section describes how to load **MicroFish** into your computer. If you haven't already done so, please make a backup copy of **MicroFish**. To make a backup, put the **MicroFish** diskette in your a: diskette drive and a blank, formatted diskette in the b: drive, then type:

copy a:.* b:* OR *diskcopy a: b:*.

Now you are ready to install **MicroFish**.

Installation: Two Disk Drive System

Place the **MicroFish** diskette in one drive and your data diskette in the other. That's all there is to it.

Installation: Hard Disk System

Create a directory for **MicroFish** and copy the **MicroFish** files to it. (The following instructions assume your hard drive is labeled C:.)

1. Type: *C:* (make the C: hard disk drive the current drive.)
2. Type: *cd* (make the root directory the current directory).
3. Type: *md\mf* (make a directory called MF for **MicroFish**)
4. Type: *cd\mf* (change the current directory to the MF directory).
5. Put the **MicroFish** diskette into the A: diskette drive.
6. Type: *copy a:*.** (copy **MicroFish** files to the C:\MF directory.)

Installation is now complete.

HOW TO RUN MICROFISH PROGRAMS

EXAMPLE: MicroFish Interactive Program

1. Type: *MF <enter>*
2. Strike any key to continue
3. Type: *Salmon River <enter>*
4. Type: *Rainbow Trout <enter>*
5. Type: *4 <enter>*
6. Type: *124 <enter> 61 <enter> 35 <enter> 14 <enter>*
7. Type: *0*

Results should be identical to output shown in appendix 1.

EXAMPLE: MicroFish Statistical Package (Output: Tables)

1. Type: *MFISH <enter>* (the title page should show after this)
2. At each pause, strike a key (do this 4 times, 1 for each display screen)
3. Type: *MF-TEST.DAT <enter>* (this is a test data file)
4. Type: *1* (send output to the screen)
5. Type: *0* (to exit)

Results should be identical to output shown in appendix 2.

EXAMPLE: MicroFish Statistical Package (Output: Database Format)

1. Type: *MFISH-DB <enter>* (the title page should show after this)
2. At each pause, strike a key (do this 4 times, 1 for each display screen)
3. Type: *1* (run one data set)

4. Type: *MF-TEST.DAT <enter>* (this is a test data file)
5. Type: *1* (send output to current directory)

A results file, MF-TEST.RES, will be created which should be identical to information shown in appendix 3.

EXAMPLE: MicroFish Sample Size Program (2-D)

1. Type: *MF-SS2D <enter>* (calculations will take some time to complete)
2. Strike any key (to continue after graph is displayed)
3. Type: *n* (to exit)

Results should be identical to output shown in appendix 5.

EXAMPLE: MicroFish Sample Size Program (3-D)

1. Type: *MF-SS3D <enter>* (calculations will take some time to complete)
2. Strike any key (to display graph)
3. Strike any key (to continue after graph is displayed)
4. Type: *n* (to exit)

Results should be identical to output shown in appendix 6.

Data Entry

MICROFISH INTERACTIVE PROGRAM

The **MicroFish Interactive Program** (program MF.EXE) receives data from user input. There are no external files accessed by this program.

Tips for Efficient Program Operation

1. Entering stream and species names are optional. Press *<enter>* to bypass these.
2. After program execution, 2 yes or no (*y* or *n*) questions ask the user if the results are to be printed and if the program is to be exited. Printing and exiting occur only if a *Y* (or a *y*) are entered. So, pressing any key (or *<enter>*) gives a "no" response to these questions.

Program Input

MICROFISH STATISTICAL PACKAGE

The **MicroFish Statistical Package** (programs MFISH.EXE and MFISH-DB.EXE) requires three sets of data input: (1) a fish file called MF-FISH.DAT containing numeric codes and fish names; (2) a parameter file called MF-PARM.DAT that can be used to enhance program operation, including detection of data errors; and (3) one or more fish capture data files. In the latter case the data files are named by the user. MFISH.EXE allows only one fish capture data file; MFISH-DB.EXE can process multiple files simultaneously.

Data files may be created with whichever line editor, text editor, word processor, etc., you have at your disposal. The data files must be saved as DOS text files (ASCII files). Some packages (for example, spreadsheets and word processors) save files under their own format, not as DOS files. In such cases be sure to use the EXPORT or TEXT IN/OUT capabilities to save files in a DOS format. The three required data files are described in detail below.

FISH FILE (MF-FISH.DAT)

This file should be created by the user to contain numeric codes that identify fish species. Each numeric code is followed by a comma and then by the actual fish name. MF-FISH.DAT currently looks like this:

1, Salmon: Chinook
2, Trout: Rainbow
3, Trout: Brook
4, Trout: Bull

5, Trout: Cutthroat
6, Trout: Brown
10, Sucker
11, Sculpin
100, Whitefish
101, Dace

The fish species code must be a whole number from 1 to 1000, inclusive. *The maximum length of the text description of the species code is 16 characters* (excess characters are truncated). If the species code in the fish capture data file fails to contain a corresponding species code in MF-FISH.DAT, an error message will be displayed during execution of the **MicroFish Statistical Package.**

This file need not be modified if the species listed above are those that are encountered by the user. Modify this file as needed to accommodate your specific needs. The user is strongly encouraged to maintain consistency among fish capture data files with regard to the numeric codes used for identifying fish species.

Because the database output option exists (with MFISH-DB.EXE), the naming of fish becomes more important. When combining multiple database files into one large file, it is often useful to sort by fish names in order to group individual species information. If species names are preceded by group names (for example, trout) then fish groups can be sorted together as well.

PARAMETER FILE (MF-PARM.DAT)

Under normal circumstances, this file should remain as is, without user modification. The file contains some user-adjustable parameters that may aid program operation or data error detection. File MF-PARM.DAT looks like this:

```
179
Y
N
scrn:
5
1.5
5000
```

Parameter 1 is the ASCII character for the vertical bar that appears on MFISH.EXE output. A table of ASCII codes exists in the appendix of your BASIC manual. Some printers are not capable of printing ASCII character 179. In such cases change the *179* in line 1 to *73,* which refers to an "I".

Parameter 2 is a parameter that controls error checking and validation of fish capture data. If you are 100 percent certain that your data have been entered in the correct format, you may change this parameter to *N* for somewhat faster program operation.

Parameter 3 controls the ability of MFISH.EXE to display contents of data files as they are read in. This may be useful for detecting data entry errors. The default for this line is an *N*. Changing line 3 to a *Y* causes data to be displayed as they are read into the **MicroFish Statistical Package**.

Parameter 4 operates in conjunction with parameter 3. If line 3 is changed to *Y*, indicating input data should be displayed, then line 4 controls the output destination. The default of *scrn:* in line 4 routes displayed data to the screen. Changing line 4 to *lpt1:* routes the output to the line printer. Changing line 4 to *data-in.lst* (or any other valid file name) directs output to a DOS file.

Parameter 5 stops the maximum-likelihood estimator from going into an infinite loop caused by a severely nondescending number of fish captured on subsequent electrofishing passes. The default of 5 stops the population estimate at five times the total catch.

Parameter 6 operates in conjunction with parameter 5. If the population estimate calculation is terminated then the population estimate is arbitrarily reset to 1.5 (the default value) times the total catch. Parameter 6 should be less than parameter 5.

To illustrate, assume the total catch equals 100 fish and parameters 5 and 6 are at their default values of 5 and 1.5, respectively. If a nondescending removal pattern of fish had taken place, the population estimate calculation would be terminated at 5 times the total catch (500) and would be reset to 1.5 times the total catch (150).

Parameter 7 is an estimate of the maximum number of observations (lines of data) in the fish capture data file for the purpose of memory allocation in the **MicroFish Statistical Package**. If you have data sets exceeding the default value of 5,000 observations, then a "Subscript out of range" error will result. In this case, simply change parameter 7 to a higher number than the actual number of observations encountered.

FISH CAPTURE DATA FILE

Fish capture data files are designed to be as simple as possible, patterned after an electrofishing tally sheet. Detailed data instructions are given below. Perhaps the quickest way to learn the data configuration, however, is to look at the sample file provided (see appendix 4). The example file of fish capture data is called MF-TEST.DAT.

Setting Up Fish Capture Data

First Line of Data—This line (called the header record) should contain study area information necessary to distinguish this data set from others. The information will appear on table form output (from MFISH.EXE), but not in database files (created by MFISH-DB.EXE). Three examples are below:

So. Fk. Salmon River, Idaho, 5/12/88
Rush Creek, CA. Fall, 1988
Third study area, test data

After the header record, subsequent lines of data pertain to captured fish. If individual fish are weighed and measured during electrofishing, then each line (record) in the data set corresponds to an individual fish. Generally, five variables (fields) are expected on each line of data. If fish are counted and weighed in groups then two additional fields are required. If no fish are caught on an electrofishing pass then only three fields are required.

Variable 1. The Site Number—This is the number of the site where the fish was captured. It must be an integer from 1 to the maximum number of sites in sequential order (don't skip numbers). That is, if only one study site is being analyzed in the data set, then the number 1 must be present throughout the length of the data file. If three study sites were electrofished, then **MicroFish** expects the numbers 1, 2, and 3 to be present somewhere in the first column of data.

Variable 2. The Electrofishing Pass Number—If four electrofishing passes were made, then this number would be a 1, 2, 3, or 4, depending on which electrofishing pass the fish was caught.

Variable 3. The Species Number—A species number should be entered here to identify the fish captured. Valid species numbers are from 1 to 1,000. Each species number must correspond to a fish name listed in the file MF-FISH.DAT. Note that species numbers in the sample fish capture data file MF-TEST.DAT (appendix 4) are 2, 3, 10, and 11, corresponding to Rainbow Trout, Brook Trout, etc., from the file of fish names, MF-FISH.DAT. If no fish were caught on the electrofishing pass, enter a 0 for species number and leave the remaining variables blank. (Actually, this last case is required only when the pass is the last in a series of removals, such as the third of three passes.)

Variable 4. The Fish Length—If a value exists, millimeters are expected. (Any units can be used for length and weight, but condition factors will be valid only with millimeters for length and grams for weight, the way the program is set up.)

Variable 5. The Fish Weight—If a value exists, grams are expected.

[Variables 6 and 7 are optional. If for some reason each individual fish was not weighed and measured, then the option of group analysis exists. A unique group must be defined for each species encountered on each electrofishing pass. If individual measurements were performed, these variables can be left blank.]

Variable 6. The Total Number of Fish Captured—If this option is used then variables 4 and 5 must contain periods instead of length and weight measurements. Periods signify missing values.

Variable 7. The Total Weight of Fish Captured—If this option is used then variables 4 and 5 must contain periods instead of length and weight measurements. If neither group weights nor individual weights were taken then put a period in the place of variable 7.

Examples of Fish Capture Data

The following examples illustrate the four allowable types of data lines (not counting the header record):

Line 1 ⇒	1	1	3	100	15.1		
Line 2 ⇒	2	2	10	.	.	3	16.8
Line 3 ⇒	3	2	11	.	.	2	.
Line 4 ⇒	3	4	0				

Line 1 identifies a fish captured from study site 1 on the first electrofishing pass. The species number of 3 indicates from file MF-FISH.DAT that a brook trout was captured. The fish was 100 millimeters in length and weighed 15.1 grams.

Line 2 refers to a group of fish captured. Note that variables 4 and 5 contain periods indicating missing values (no individual fish measurements). This group of fish was captured from study site 2 on the second electrofishing pass. Species number of 10 refers to suckers according to file MF-FISH.DAT. Three suckers were captured with a group weight of 16.8 grams.

Line 3 identifies fish captured in study site 3 on the second electrofishing pass. Species number 11 refers to sculpin. Two fish were captured. No group weight was taken.

Line 4 represents a special situation. In study site 3 on electrofishing pass 4 no fish were captured. In such cases a zero should be entered for the species number. No length and weight information should be entered. A species number of zero is the only species number that will not have a corresponding species name in the file of fish names, MF-FISH.DAT. This special record type is only required when no fish are caught in the entire study area on the last of a series of removals (it signals to **MicroFish** how many electrofishing passes were made).

Notes on Fish Capture Data

Note 1. Data Delimiters—All variables need to be separated by at least one blank space (or a comma, or both). Do not put blank lines in the data.

Note 2. Mixing Individual and Group Measurements—The **MicroFish Statistical Package** is not capable of performing calculations on a data set in which a single species has a mixture of individually weighed fish and fish weighed in groups. Species A may have grouped measurements and Species B may have individual fish measurements in the same data set, but don't mix individuals and groups within the same species.

Note 3. Number of Electrofishing Passes—The **MicroFish Statistical Package** is capable of comparing several study sites within a study area. The

same number of electrofishing passes must be made at each site in a data set. The largest electrofishing pass number in the data is assumed to be the number of passes at each site.

Program Output

OUTPUT: TABLE FORMAT

MFISH.EXE is capable of outputting fisheries population estimates and statistics in tabular form to the screen, to a line printer, or to a data file. (See appendix 2.)

OUTPUT: DATA-BASE FORMAT

MFISH-DB.EXE creates output data files only. Output files can be sent to any disk drive or directory designated by the user. The following file definition describes the output format from program MFISH-DB.EXE:

Field name	Starting column	Ending column	Field length	Data type
Data file Name	1	12	12	Character
Variable Sort Field	14	15	2	Numeric
Species Sort Field	16	17	2	Numeric
Variable Name	19	30	12	Character
Removal Number	32	32	1	Numeric
Species Name	34	49	16	Character
Overall Value	50	59	10	Numeric
Site 1 Value	60	69	10	Numeric
Site 2 Value	70	79	10	Numeric
Site 3 Value	80	89	10	Numeric

There will be a minimum of one site listed in the output. The output will vary in length, depending on the number of sites sampled. Each site adds 10 characters to the output record length. (See appendix 3.)

OUTPUT FILE EXTENSIONS FROM MFISH-DB.EXE

All MFISH-DB.EXE output results are automatically given a ".RES" file name extension. For example, if a file named FISH1988.DAT is used as input then the results file will be labeled FISH1988.RES.

PROCESSING MULTIPLE DATA FILES WITH MFISH-DB.EXE

MFISH-DB.EXE allows one to process several data sets at once or one at a time. If processing several data sets, a file must be created containing a list of data file names. The data in this list will be processed sequentially. For example, assume the file FISHDATA.LST contains a list of the following fish data files that reside in the DAT87 and DAT88 directories on the C: disk drive:

C:\DAT87\F87-IDAH.DAT
C:\DAT87\F87-OREG.DAT
C:\DAT87\F87-WASH.DAT
C:\DAT88\F88-IDAH.DAT
C:\DAT88\F88-OREG.DAT
C:\DAT88\F88-WASH.DAT

When MFISH-DB prompts

1—Run one data set
2—Run more than one data set

press "2". The user is then prompted

Enter the name of the file
containing data file names:

Now type *FISHDATA.LST <enter>*, or whatever name you've chosen for the file you created with the list of fish data file names. Output for all six files will be generated.

[Hint: To facilitate creation of data file lists use a DOS "piping" command. For example, typing *DIR *.DAT > FISHDATA.LST* creates a file called FISHDATA.LST consisting of all files with a ".DAT" extension. Use an editor to "clean up" nonessential information from this newly created list of data file names.]

Tips for Efficient Program Operation

BYPASSING DIPSLAY SCREENS

Display screens in programs MFISH.EXE and MFISH-DB.EXE can be bypassed by pressing the *ESC*ape key at the initial title page.

ACCESSING DISK DRIVES AND DIRECTORIES

Specification of PATH calls preceding input or output file names allows the user to retrieve or send data to selected disk drives or directories. For example:

Input data file: A:FISH.DAT
Output data file: C:\OUTPUT\RESULTS.88

In this example the input file FISH.DAT is read from disk drive A. The output file RESULTS.88 is sent to the OUTPUT directory on disk drive C. In the case of database output (from program MFISH-DB.EXE) only the output directory should be specified because file name extensions (".RES") are automatically assigned.

Commonly Asked Questions

Q: *Does data in the fish capture data file need to be in any order?*
A: No, as long as the header record is the first line in the data.

Q: *Can species be subdivided by age-groups?*
A: Yes, the species file MF-FISH.DAT can be set up any way the user desires. Simply change the fish file species codes and descriptions to accommodate your needs. Don't forget to change the species codes in the fish capture data file to their new values. It may be preferable to copy the old fish capture data file to a new file. Then, change the species codes in the new file.

Example: Suppose you ran the **MicroFish Statistical Package** on a data file that only contained rainbow trout (species code 2 according to the original values). After scanning the data, you realize that clear age-class breaks can be made at 100 and 200 mm. The following three species codes might be added to the MF-FISH.DAT data file:

20, "RBT < 100 mm"
21, "RBT 100-200 mm"
22, "RBT > 200 mm"

Once these new species codes are established in MF-FISH.DAT, the fish capture data should be modified to reflect these changes. Rerun the **MicroFish Statistical Package** to produce population statistics by age class.

Q: *How do I compare the same study area over a period of 4 years?*
A: Define each year's data as a particular site. For example, this year's data would be considered site 4, last year's data would be site 3, etc.

Q: *I didn't collect lengths or weights. How do I process my data?*
A: Lengths and weights are not required. In such cases, use the format of example Line 3 where individual length and weight and group weight have missing values. A group total of 1 is permissible.

Q: *How can I summarize my fisheries data by date, location, or species?*
A: Combine all the necessary database files (output from MFISH-DB.EXE) into one large file. If data file names (which are included on each line of output) have been consistently set up to include year and study area, then one can sort on the appropriate fields to organize data by year, location, and species. An example data

file naming convention is F88-AREA.DAT where F refers to fisheries data (as opposed to H for habitat, S for sediment, etc.), 88 refers to the year, and AREA is a four character designation for the sampling location.

MICROFISH SAMPLE SIZE PROGRAMS

Purpose

The sample size software (programs MF-SS2D.EXE and MF-SS3D.EXE) answers the question of how many electrofishing passes are required to yield desired levels of precision in the maximum-likelihood population estimate. It is assumed that electrofishing is performed using removal-depletion sampling.

A more complete paper, which discusses the interrelationships among population size (N), catchability (P), population estimate precision, and the number of electrofishing passes (T), is currently in preparation.

Definitions

Catchability is defined as the proportion of fish captured on a given electrofishing pass (for example, each electrofishing pass captures 50 percent of the fish remaining in the stream).

Precision is described in terms of the coefficient of precision, CP(N), a statistic developed by the authors for ease of use. The value associated with the coefficient of precision indicates that the true population size is within a given percentage of the population estimate. Therefore, if the coefficient of precision is 10, then the true population size is within 10 percent of the sample estimate at the 95 percent confidence level. If N = 500 and CP(500) = 10 then the 95 percent confidence limits around N would equal 450 and 550, respectively.

Introduction

There are two **MicroFish** programs for assessing and understanding electrofishing sample size requirements for population estimation. Computer graphics capabilities are required for both programs.

The first program, MF-SS2D.EXE, shows sample size relationships among N, P, T, and CP(N) in two dimensions (2-D). The graph generated by this program has labeled axes and is suitable for field use.

The second program, MF-SS3D.EXE, displays sample size relationships in three-dimensional (3-D) format to provide an improved conceptual understanding of the relationships among N, P, T, and CP(N). Although no axis labels are provided, the X axis refers to population estimate, the Y axis represents catchability, and the Z axis identifies the coefficient of precision reached by successive electrofishing passes.

Printing

To print graphs from the computer screen, one must type in the word *GRAPHICS* (a DOS command) before running the program, then press the Print-Screen key once the graph is displayed.

Adaptability

The graphics are flexible such that the range of parameters [N, P, T, and CP(N)] can be adjusted to investigate all possible relationships. Color parameters in the software are also adjustable. To change these parameters simply modify the sample size files, MF-SS2D.FIL and MF-SS3D.FIL. These files are automatically read by the corresponding sample size program each time a program is run.

Adjustable Parameters: MicroFish Sample Size Graph (2-D)

The following is an example of MF-SS2D.FIL:

```
 50   350    50
 30    70     5
  2     6     1
 50     1    10     1
  9     1     3     2     1
```

Line 1 sets the range of population estimates from 50 to 350 in increments of 50. Line 2 sets catchability from 30 percent to 70 percent in 5 percent increments. Line 3 sets the number of electrofishing passes from 2 to 6 in increments of 1 (two passes minimum are required).

Parameter 1 of Line 4 sets the maximum CP(N) at 50. Parameter 2 should equal 1 to display CP(N) scales, zero to suppress scales. Parameter 3 sets the number of increments to be made on the CP(N) scale. In the case shown above, precision levels up to CP(N) = 50 will be shown in 10 increments (0, 5, 10, ..., 50). Parameter 4 displays precision lines behind display bars if the parameter value is 1. These lines are suppressed if parameter 4 is 0.

On Line 5, parameter 1 sets the background color (text mode) for the axis labels. Parameters 2 through 5 set the colors (graphics mode) for palette, graph background color, border color, and scale line color, respectively. Graphics mode colors range from 0 to 3. Refer to an IBM (or compatible) Basic manual.

Adjustable Parameters: MicroFish Sample Size Graph (3-D)

The following is an example of MF-SS3D.FIL:

```
 50    300     50
 25     75      5
  2      6      1
 50
  9      0      3
```

The MF-SS3D.FIL is exactly analogous, except that fewer adjustable parameters are present in line 4. Line 5 lists background color, palette, and line color.

Assessing Sampling Requirements

To estimate electrofishing sample size it is necessary to make rough predictions of N and P and to choose a desired precision level. The likelihood of meeting precision goals during actual sampling will be increased if the estimates for N and P are conservative (lower than the true values).

If one species of the sampled population is of particular interest, the values of N and P for that individual species should be used when determining the number of electrofishing passes needed.

Sample size graphs are displayed with several groups of columns, one group for each population estimate. Each group of columns represents the range of catchabilities specified by the user. Find the most appropriate values of N and P on the graph, then proceed vertically up the column until you reach the desired precision level listed on the left-hand axis. The color of the bar at that point indicates the number of electrofishing passes required to reach that precision level given the values of N and P. This is the number of electrofishing passes that should be made in the field.

MICROFISH VERSION 3.0 ENHANCEMENTS

1. The **MicroFish Statistical Package (Database Format)**, MFISH-DB.EXE, enables **MicroFish** output to be readily used by other commercial packages. In effect, the output from MFISH-DB.EXE can be imported directly into graphics packages, database managers, spreadsheets, etc.

2. MFISH-DB.EXE permits multiple data file processing.

3. Biomass calculations are performed. Relative percentages of biomass are calculated by species and site.

4. The database format facilitates output file management, file integration, and file coordination.

MICROFISH TECHNICAL NOTES

MicroFish programs perform maximum-likelihood population estimates based on the number of fish captured on each electrofishing pass (Van Deventer and Platts 1983). Under certain circumstances a maximum-likelihood calculation is not possible (see the Error Handling section).

Values of the Student's *t* distribution used in confidence intervals are taken to 3 decimal places for 100 and fewer degrees of freedom; 2 decimal places for less than 100 degrees of freedom. When the population estimate lower confidence interval is less than the total catch, the lower CI is set equal to the total catch. In this case the **MicroFish Interactive Program** will issue a message. The **MicroFish Statistical Package** will not.

The DOS operating system provides three key sequences that are useful with any program:

Cntl-NumLock—These two keys pressed simultaneously halt the "scrolling" of information on the screen. Pressing any key resumes the scrolling.
Cntl-Break—Terminates program execution at any time.
Alt-Cntl-Del—Terminates all operations and reboots the computer.

ERROR HANDLING

Population Estimate Errors

Maximum-likelihood estimation is not possible in four situations:

1. if a total of 1 fish is caught on all passes,
2. if all fish are caught on the first pass,
3. if there is a severely nondescending removal pattern, or
4. if no fish were caught in the sampling site.

The **MicroFish Statistical Package (Database Format)** will list error numbers in the output file. The **MicroFish Statistical Package (Table Format)** will display the following error messages on the screen when a maximum-likelihood population estimate cannot be calculated:

1 No maximum likelihood estimate generated. Reason: only 1 fish caught in all removals.

2 No maximum likelihood estimate generated. Reason: all fish caught on first pass.

3 Maximum likelihood estimate terminated at 5 times the total catch. Estimate has been arbitrarily reset to 1.5 times the total catch according to MF-PARM.DAT. Population estimate termination was caused by a nondescending removal pattern. Results should not be considered reliable.

4 No maximum likelihood estimate generated. Reason: no fish captured.

In the first, second, and fourth cases the population estimate is set equal to the total catch. Statistics associated with capture probability are set to zero. How **MicroFish** handles the third case is discussed in the "PARAMETER FILE (MF-PARM.DAT)" section of the user's guide (see parameters 5 and 6).

Two of these situations are illustrated by running the example data, MF-TEST.DAT, where removal patterns are flagged and warning messages are issued.

Out of Memory Errors

An "out of memory" error will occur if your computer doesn't have enough memory for both the program and the data. If you have a RAM disk or any other memory-resident modules, reboot your computer without loading them. If that doesn't work, reduce parameter 7 in the MF-PARM.DAT file from the default value of 5,000 down to the number of data lines your fish capture data actually have and rerun the **MicroFish Statistical Package.**

Other Errors

Data entry errors and improper data formatting are the two biggest problems encountered by **MicroFish** users. Should you encounter an error, try the diagnostic aids recommended in the "PARAMETER FILE (MF-PARM.DAT)" section. Also, sort a copy of your data and check for (1) non-sequential assignment of site numbers (other than 1, 2, 3, etc.), (2) species weights of zero, and (3) mixture of individual and grouped measurements within a single species. Any of these three conditions will cause the program to terminate.

If all else fails, contact the authors for help.

REFERENCES

Van Deventer, J. S.; Platts, W. S. 1983. Sampling and estimating fish populations from streams. Transactions of the North American Wildlife and Natural Resources Conference. 48: 349-354.

Van Deventer, J. S.; Platts, W. S. 1985. A computer software system for entering, managing, and analyzing fish capture data from streams. Res. Note INT-352. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 12 p.

APPENDIX 1: OUTPUT EXAMPLE FROM THE MICROFISH INTERACTIVE PROGRAM (MF. EXE)

Stream: South Fork Salmon River
Species: Rainbow Trout

Removal Pattern:	124 61 35 14	
Total Catch	=	234
Population Estimate	=	249
Chi Square	=	0.675
Pop Est Standard Err	=	6.164
Lower Conf Interval	=	236.858
Upper Conf Interval	=	261.142
Capture Probability	=	0.501
Capt Prob Standard Err	=	0.035
Lower Conf Interval	=	0.432
Upper Conf Interval	=	0.570

APPENDIX 2: OUTPUT EXAMPLE FROM THE MICROFISH STATISTICAL PACKAGE (MFISH.EXE)

FISH SAMPLING RESULTS

TITLE: MICROFISH TEST DATA
FILE: mf-test.dat
DATE: 09-07-88 1:28 p.m.

Number of Sites = 3
Number of Removals = 4
Number of Species = 4

REMOVAL PATTERNS

	SPECIES	SITE	RMVL 1	RMVL 2	RMVL 3	RMVL 4
	Trout: Rainbow	1	11	5	3	2
	Trout: Rainbow	2	6	5	2	1
	Trout: Rainbow	3	13	7	5	2
	Trout: Brook	1	22	7	6	3
	Trout: Brook	2	18	11	6	3
	Trout: Brook	3	20	12	4	4
	Sucker	1	19	11	6	2
	Sucker	2	4	2	0	1
	Sucker	3	6	3	3	1
	Sculpin	1	12	7	3	0
2	Sculpin	2	4	0	0	0
3	Sculpin	3	3	2	5	5
	Trout: Rainbow	All Sites	30	17	10	5
	Trout: Brook	All Sites	60	30	16	10
	Sucker	All Sites	29	16	9	4
	Sculpin	All Sites	19	9	8	5
	All Species	1	64	30	18	7
	All Species	2	32	18	8	5
	All Species	3	42	24	17	12
	All Species	All Sites	138	72	43	24

WARNING

2 No maximum likelihood estimate generated.
Reason: all fish caught on 1st pass.

3 Maximum likelihood estimate terminated at 5 times the total catch. Estimate has been arbitrarily reset to 1.5 times the total catch according to MF-PARM.DAT. Population estimate termination was caused by a non-descending removal pattern. Results should not be considered reliable.

APPENDIX 2: (Con.)

FISH CAPTURE TOTALS (% by Species)

SPECIES	SITE = 1		SITE = 2		SITE = 3		TOTAL	
	#FISH	%	#FISH	%	#FISH	%	#FISH	%
Trout: Rainbow	21	33.9%	14	22.6%	27	43.5%	62	100.0%
Trout: Brook	38	32.8%	38	32.8%	40	34.5%	116	100.0%
Sucker	38	65.5%	7	12.1%	13	22.4%	58	100.0%
Sculpin	22	53.7%	4	9.8%	15	36.6%	41	100.0%
TOTAL	119	43.0%	63	22.7%	95	34.3%	277	100.0%

FISH CAPTURE TOTALS (% by Site)

SPECIES	SITE = 1		SITE = 2		SITE = 3		TOTAL	
	#FISH	%	#FISH	%	#FISH	%	#FISH	%
Trout: Rainbow	21	17.6%	14	22.2%	27	28.4%	62	22.4%
Trout: Brook	38	31.9%	38	60.3%	40	42.1%	116	41.9%
Sucker	38	31.9%	7	11.1%	13	13.7%	58	20.9%
Sculpin	22	18.5%	4	6.3%	15	15.8%	41	14.8%
TOTAL	119	100.0%	63	100.0%	95	100.0%	277	100.0%

POPULATION ESTIMATES (% by Species)

SPECIES	SITE = 1		SITE = 2		SITE = 3		TOTAL		
	EST	%	EST	%	EST	%	TOTAL	%	EST
Trout: Rainbow	22	33.8%	14	21.5%	29	44.6%	65	100%	67
Trout: Brook	39	32.0%	41	33.6%	42	34.4%	122	100%	125
Sucker	40	65.6%	7	11.5%	14	23.0%	61	100%	62
Sculpin	22	44.9%	4	8.2%	23	46.9%	49	100%	47
SITE ESTIMATES	126	41.2%	67	21.9%	113	36.9%	306	100%	305

APPENDIX 2: (Con.)

POPULATION ESTIMATES (% by Site)

SPECIES	SITE = 1		SITE = 2		SITE = 3		TOTAL	
	EST	%	EST	%	EST	%	EST	%
Trout: Rainbow	22	17.9%	14	21.2%	29	26.9%	67	22.3%
Trout: Brook	39	31.7%	41	62.1%	42	38.9%	125	41.5%
Sucker	40	32.5%	7	10.6%	14	13.0%	62	20.6%
Sculpin	22	17.9%	4	6.1%	23	21.3%	47	15.6%
ESTIMATE TOTALS	123	100.0%	66	100.0%	108	100.0%	301	100.0%
SITE ESTIMATES	126		67		113		305	

POPULATION ESTIMATE STANDARD ERRORS

SPECIES	SITE = 1	SITE = 2	SITE = 3	TOTAL
Trout: Rainbow	1.844	1.154	2.631	4.071
Trout: Brook	1.873	3.170	2.548	5.132
Sucker	2.385	0.612	2.038	3.439
Sculpin	0.802	0.000	0.000	5.417
SITE STD ERROR	4.183	3.381	10.016	9.561

POPULATION ESTIMATE 95% CONFIDENCE INTERVALS

SPECIES	SITE = 1	SITE = 2	SITE = 3	TOTAL
Trout: Rainbow	21, 26	14, 16	27, 34	62, 75
Trout: Brook	38, 43	38, 47	40, 47	116, 135
Sucker	38, 45	7, 8	13, 18	58, 69
Sculpin	22, 24	4, 4	0, 0	41, 58
SITE ESTIMATES	119, 134	63, 74	95, 133	286, 324

APPENDIX 2: (Con.)

CAPTURE PROBABILITIES

SPECIES	SITE = 1	SITE = 2	SITE = 3	TOTAL
Trout: Rainbow	0.5000	0.5385	0.4655	0.4627
Trout: Brook	0.5429	0.4634	0.5000	0.4754
Sucker	0.5067	0.5833	0.4483	0.4833
Sculpin	0.6286	0.0000	0.0000	0.3905
SITE TOTAL	0.5085	0.4922	0.3640	0.4475

CAPTURE PROBABILITY STANDARD ERROR

SPECIES	SITE = 1	SITE = 2	SITE = 3	TOTAL
Trout: Rainbow	0.1186	0.1416	0.1081	0.0714
Trout: Brook	0.0844	0.0912	0.0858	0.0514
Sucker	0.0872	0.1895	0.1593	0.0722
Sculpin	0.1012	0.0000	0.0000	0.0946
SITE CAPT S.E.	0.0490	0.0686	0.0636	0.0342

CAPTURE PROBABILITY 95% CONFIDENCE INTERVALS

SPECIES	SITE = 1	SITE = 2	SITE = 3	TOTAL
Trout: Rainbow	0.2534, 0.7466	0.2326, 0.8443	0.2442, 0.6869	0.3201, 0.6052
Trout: Brook	0.3721, 0.7136	0.2792, 0.6476	0.3267, 0.6733	0.3737, 0.5771
Sucker	0.3303, 0.6830	0.1195, 1.0471	0.1043, 0.7923	0.3390, 0.6277
Sculpin	0.4180, 0.8392	0.0000, 0.0000	0.0000, 0.0000	0.2001, 0.5809
SITE 95% C.I.	0.4115, 0.6056	0.3551, 0.6292	0.2380, 0.4899	0.3802, 0.5148

APPENDIX 2: (Con.)

CHI SQUARE GOODNESS OF FIT

SPECIES	SITE = 1	SITE = 2	SITE = 3	TOTAL
Trout: Rainbow	0.3591	1.1960	0.3708	0.1757
Trout: Brook	1.8203	0.1731	1.2897	0.2947
Sucker	0.4914	2.4504	0.7051	0.1809
Sculpin	2.2600	0.0000	0.0000	0.8322
SITE TOTAL	0.5315	0.2636	0.3971	0.2562

CONDITION FACTORS

SPECIES	SITE = 1	SITE = 2	SITE = 3	TOTAL
Trout: Rainbow	1.320	1.126	1.346	1.288
Trout: Brook	1.232	1.331	1.197	1.252

AVERAGE LENGTHS

SPECIES	SITE = 1	SITE = 2	SITE = 3	TOTAL
Trout: Rainbow	77.9	86.8	70.4	76.7
Trout: Brook	87.0	90.3	72.6	83.1

LENGTH STANDARD DEVIATIONS

SPECIES	SITE = 1	SITE = 2	SITE = 3	TOTAL
Trout: Rainbow	31.278	40.971	30.719	33.494
Trout: Brook	36.610	34.146	33.927	35.459

LENGTH 95% CONFIDENCE INTERVALS

SPECIES	SITE = 1	SITE = 2	SITE = 3	TOTAL
Trout: Rainbow	63.7, 92.1	63.1, 110.4	58.3, 82.6	68.2, 85.2
Trout: Brook	75.0, 99.1	79.1, 101.6	61.8, 83.5	76.6, 89.7

APPENDIX 2: (Con.)

TOTAL WEIGHTS (% by Species)

SPECIES	SITE = 1		SITE = 2		SITE = 3		TOTAL	
	WEIGHT	%	WEIGHT	%	WEIGHT	%	WEIGHT	%
Trout: Rainbow	188	33.3%	183	32.5%	193	34.2%	565	100.0%
Trout: Brook	474	35.7%	527	39.7%	326	24.5%	1327	100.0%
Sucker	230	66.5%	35	10.2%	81	23.3%	347	100.0%
TOTAL	893	39.9%	746	33.3%	600	26.8%	2238	100.0%

TOTAL WEIGHTS (% by Site)

SPECIES	SITE = 1		SITE = 2		SITE = 3		TOTAL	
	WEIGHT	%	WEIGHT	%	WEIGHT	%	WEIGHT	%
Trout: Rainbow	188	21.1%	183	24.6%	193	32.2%	565	25.2%
Trout: Brook	474	53.1%	527	70.7%	326	54.3%	1327	59.3%
Sucker	230	25.8%	35	4.7%	81	13.5%	347	15.5%
TOTAL	893	100.0%	746	100.0%	600	100.0%	2238	100.0%

AVERAGE WEIGHTS

SPECIES	SITE = 1	SITE = 2	SITE = 3	TOTAL
Trout: Rainbow	9.0	13.1	7.2	9.1
Trout: Brook	12.5	13.9	8.1	11.4
Sucker	6.1	5.0	6.2	6.0

WEIGHT STANDARD DEVIATIONS

SPECIES	SITE = 1	SITE = 2	SITE = 3	TOTAL
Trout: Rainbow	9.126	16.036	10.996	11.790
Trout: Brook	13.525	17.416	16.030	15.801

APPENDIX 2: (Con.)

WEIGHT 95% CONFIDENCE INTERVALS

SPECIES	SITE = 1	SITE = 2	SITE = 3	TOTAL
Trout: Rainbow	4.8, 13.1	3.8, 22.4	2.8, 11.5	6.1, 12.1
Trout: Brook	8.0, 16.9	8.1, 19.6	3.0, 13.3	8.5, 14.3

ESTIMATED BIOMASS (% by Spec)

SPECIES	SITE = 1		SITE = 2		SITE = 3		TOTAL	
	BIOMASS	%	BIOMASS	%	BIOMASS	%	BIOMASS	%
Trout: Rainbow	197	33.5%	183	31.2%	208	35.3%	588	100.0%
Trout: Brook	487	34.8%	568	40.7%	342	24.5%	1397	100.0%
Sucker	243	66.5%	35	9.6%	87	23.8%	365	100.0%
TOTAL	926	39.4%	787	33.5%	637	27.1%	2350	100.0%

ESTIMATED BIOMASS (% by Site)

SPECIES	SITE = 1		SITE = 2		SITE = 3		TOTAL	
	BIOMASS	%	BIOMASS	%	BIOMASS	%	BIOMASS	%
Trout: Rainbow	197	21.3%	183	23.3%	208	32.6%	588	25.0%
Trout: Brook	487	52.5%	568	72.2%	342	53.7%	1397	59.5%
Sucker	243	26.2%	35	4.5%	87	13.7%	365	15.5%
TOTAL	926	100.0%	787	100.0%	637	100.0%	2350	100.0%

APPENDIX 3: OUTPUT EXAMPLE FROM THE MICROFISH STATISTICAL PACKAGE (MFISH-DB.EXE)

MF-TEST .DAT	1	0	Fish Removal	1	ALL SPECIES	138	64	32	42
MF-TEST .DAT	1	0	Fish Removal	2	ALL SPECIES	72	30	18	24
MF-TEST .DAT	1	0	Fish Removal	3	ALL SPECIES	43	18	8	17
MF-TEST .DAT	1	0	Fish Removal	4	ALL SPECIES	24	7	5	12
MF-TEST .DAT	1	1	Fish Removal	1	Trout: Rainbow	30	11	6	13
MF-TEST .DAT	1	1	Fish Removal	2	Trout: Rainbow	17	5	5	7
MF-TEST .DAT	1	1	Fish Removal	3	Trout: Rainbow	10	3	2	5
MF-TEST .DAT	1	1	Fish Removal	4	Trout: Rainbow	5	2	1	2
MF-TEST .DAT	1	2	Fish Removal	1	Trout: Brook	60	22	18	20
MF-TEST .DAT	1	2	Fish Removal	2	Trout: Brook	30	7	11	12
MF-TEST .DAT	1	2	Fish Removal	3	Trout: Brook	16	6	6	4
MF-TEST .DAT	1	2	Fish Removal	4	Trout: Brook	10	3	3	4
MF-TEST .DAT	1	3	Fish Removal	1	Sucker	29	19	4	6
MF-TEST .DAT	1	3	Fish Removal	2	Sucker	16	11	2	3
MF-TEST .DAT	1	3	Fish Removal	3	Sucker	9	6	0	3
MF-TEST .DAT	1	3	Fish Removal	4	Sucker	4	2	1	1
MF-TEST .DAT	1	4	Fish Removal	1	Sculpin	19	12	4	3
MF-TEST .DAT	1	4	Fish Removal	2	Sculpin	9	7	0	2
MF-TEST .DAT	1	4	Fish Removal	3	Sculpin	8	3	0	5
MF-TEST .DAT	1	4	Fish Removal	4	Sculpin	5	0	0	5
MF-TEST .DAT	2	0	Rmvl Warning		ALL SPECIES	0	0	0	0
MF-TEST .DAT	2	1	Rmvl Warning		Trout: Rainbow	0	0	0	0
MF-TEST .DAT	2	2	Rmvl Warning		Trout: Brook	0	0	0	0
MF-TEST .DAT	2	3	Rmvl Warning		Sucker	0	0	0	0
MF-TEST .DAT	2	4	Rmvl Warning		Sculpin	0	0	2	3
MF-TEST .DAT	3	0	Fish Totals		ALL SPECIES	277	119	63	95
MF-TEST .DAT	3	1	Fish Totals		Trout: Rainbow	62	21	14	27
MF-TEST .DAT	3	2	Fish Totals		Trout: Brook	116	38	38	40
MF-TEST .DAT	3	3	Fish Totals		Sucker	58	38	7	13
MF-TEST .DAT	3	4	Fish Totals		Sculpin	41	22	4	15
MF-TEST .DAT	4	0	Fish %--Spec		ALL SPECIES	100.0	43.0	22.7	34.3
MF-TEST .DAT	4	1	Fish %--Spec		Trout: Rainbow	100.0	33.9	22.6	43.5
MF-TEST .DAT	4	2	Fish %--Spec		Trout: Brook	100.0	32.8	32.8	34.5
MF-TEST .DAT	4	3	Fish %--Spec		Sucker	100.0	65.5	12.1	22.4
MF-TEST .DAT	4	4	Fish %--Spec		Sculpin	100.0	53.7	9.8	36.6
MF-TEST .DAT	5	0	Fish %--Site		ALL SPECIES	100.0	100.0	100.0	100.0
MF-TEST .DAT	5	1	Fish %--Site		Trout: Rainbow	22.4	17.6	22.2	28.4
MF-TEST .DAT	5	2	Fish %--Site		Trout: Brook	41.9	31.9	60.3	42.1
MF-TEST .DAT	5	3	Fish %--Site		Sucker	20.9	31.9	11.1	13.7
MF-TEST .DAT	5	4	Fish %--Site		Sculpin	14.8	18.5	6.3	15.8
MF-TEST .DAT	6	0	Pop Estimate		ALL SPECIES	305	126	67	113
MF-TEST .DAT	6	1	Pop Estimate		Trout: Rainbow	67	22	14	29
MF-TEST .DAT	6	2	Pop Estimate		Trout: Brook	125	39	41	42
MF-TEST .DAT	6	3	Pop Estimate		Sucker	62	40	7	14
MF-TEST .DAT	6	4	Pop Estimate		Sculpin	47	22	4	23
MF-TEST .DAT	7	0	Est %--Spec		ALL SPECIES	100.0	41.2	21.9	36.9
MF-TEST .DAT	7	1	Est %--Spec		Trout: Rainbow	100.0	33.8	21.5	44.6
MF-TEST .DAT	7	2	Est %--Spec		Trout: Brook	100.0	32.0	33.6	34.4
MF-TEST .DAT	7	3	Est %--Spec		Sucker	100.0	65.6	11.5	23.0
MF-TEST .DAT	7	4	Est %--Spec		Sculpin	100.0	44.9	8.2	46.9
MF-TEST .DAT	8	0	Est %--Site		ALL SPECIES	100.0	100.0	100.0	100.0
MF-TEST .DAT	8	1	Est %--Site		Trout: Rainbow	22.3	17.9	21.2	26.9
MF-TEST .DAT	8	2	Est %--Site		Trout: Brook	41.5	31.7	62.1	38.9
MF-TEST .DAT	8	3	Est %--Site		Sucker	20.6	32.5	10.6	13.0

APPENDIX 3: (Con.)

MF-TEST .DAT	8	4	Est %--Site	Sculpin	15.6	17.9	6.1	21.3
MF-TEST .DAT	9	0	Est Std Err	ALL SPECIES	9.561	4.183	3.381	10.016
MF-TEST .DAT	9	1	Est Std Err	Trout: Rainbow	4.071	1.844	1.154	2.631
MF-TEST .DAT	9	2	Est Std Err	Trout: Brook	5.132	1.873	3.170	2.548
MF-TEST .DAT	9	3	Est Std Err	Sucker	3.439	2.385	0.612	2.038
MF-TEST .DAT	9	4	Est Std Err	Sculpin	5.417	0.802	0.000	0.000
MF-TEST .DAT	10	0	Est Lower CI	ALL SPECIES	286	119	63	95
MF-TEST .DAT	10	1	Est Lower CI	Trout: Rainbow	62	21	14	27
MF-TEST .DAT	10	2	Est Lower CI	Trout: Brook	116	38	38	40
MF-TEST .DAT	10	3	Est Lower CI	Sucker	58	38	7	13
MF-TEST .DAT	10	4	Est Lower CI	Sculpin	41	22	4	0
MF-TEST .DAT	11	0	Est Upper CI	ALL SPECIES	324	134	74	133
MF-TEST .DAT	11	1	Est Upper CI	Trout: Rainbow	75	26	16	34
MF-TEST .DAT	11	2	Est Upper CI	Trout: Brook	135	43	47	47
MF-TEST .DAT	11	3	Est Upper CI	Sucker	69	45	8	18
MF-TEST .DAT	11	4	Est Upper CI	Sculpin	58	24	4	0
MF-TEST .DAT	12	0	Capt Prob	ALL SPECIES	0.447	0.509	0.492	0.364
MF-TEST .DAT	12	1	Capt Prob	Trout: Rainbow	0.463	0.500	0.538	0.466
MF-TEST .DAT	12	2	Capt Prob	Trout: Brook	0.475	0.543	0.463	0.500
MF-TEST .DAT	12	3	Capt Prob	Sucker	0.483	0.507	0.583	0.448
MF-TEST .DAT	12	4	Capt Prob	Sculpin	0.390	0.629	0.000	0.000
MF-TEST .DAT	13	0	Capt Prob SE	ALL SPECIES	0.034	0.049	0.069	0.064
MF-TEST .DAT	13	1	Capt Prob SE	Trout: Rainbow	0.071	0.119	0.142	0.108
MF-TEST .DAT	13	2	Capt Prob SE	Trout: Brook	0.051	0.084	0.091	0.086
MF-TEST .DAT	13	3	Capt Prob SE	Sucker	0.072	0.087	0.190	0.159
MF-TEST .DAT	13	4	Capt Prob SE	Sculpin	0.095	0.101	0.000	0.000
MF-TEST .DAT	14	0	C P Lower CI	ALL SPECIES	0.380	0.412	0.355	0.238
MF-TEST .DAT	14	1	C P Lower CI	Trout: Rainbow	0.320	0.253	0.233	0.244
MF-TEST .DAT	14	2	C P Lower CI	Trout: Brook	0.374	0.372	0.279	0.327
MF-TEST .DAT	14	3	C P Lower CI	Sucker	0.339	0.330	0.120	0.104
MF-TEST .DAT	14	4	C P Lower CI	Sculpin	0.200	0.418	0.000	0.000
MF-TEST .DAT	15	0	C P Upper CI	ALL SPECIES	0.515	0.606	0.629	0.490
MF-TEST .DAT	15	1	C P Upper CI	Trout: Rainbow	0.605	0.747	0.844	0.687
MF-TEST .DAT	15	2	C P Upper CI	Trout: Brook	0.577	0.714	0.648	0.673
MF-TEST .DAT	15	3	C P Upper CI	Sucker	0.628	0.683	1.047	0.792
MF-TEST .DAT	15	4	C P Upper CI	Sculpin	0.581	0.839	0.000	0.000
MF-TEST .DAT	16	0	Chi Square	ALL SPECIES	0.256	0.532	0.264	0.397
MF-TEST .DAT	16	1	Chi Square	Trout: Rainbow	0.176	0.359	1.196	0.371
MF-TEST .DAT	16	2	Chi Square	Trout: Brook	0.295	1.820	0.173	1.290
MF-TEST .DAT	16	3	Chi Square	Sucker	0.181	0.491	2.450	0.705
MF-TEST .DAT	16	4	Chi Square	Sculpin	0.832	2.260	0.000	0.000
MF-TEST .DAT	17	1	Cond Factor	Trout: Rainbow	1.288	1.320	1.126	1.346
MF-TEST .DAT	17	2	Cond Factor	Trout: Brook	1.252	1.232	1.331	1.197
MF-TEST .DAT	18	1	Avg Length	Trout: Rainbow	76.661	77.905	86.786	70.444
MF-TEST .DAT	18	2	Avg Length	Trout: Brook	83.147	87.026	90.342	72.625
MF-TEST .DAT	19	1	Len Std Dev	Trout: Rainbow	33.494	31.278	40.971	30.719
MF-TEST .DAT	19	2	Len Std Dev	Trout: Brook	35.459	36.610	34.146	33.927
MF-TEST .DAT	20	1	Len Lower CI	Trout: Rainbow	68.154	63.667	63.134	58.290
MF-TEST .DAT	20	2	Len Lower CI	Trout: Brook	76.628	74.994	79.120	61.773
MF-TEST .DAT	21	1	Len Upper CI	Trout: Rainbow	85.169	92.142	110.438	82.599
MF-TEST .DAT	21	2	Len Upper CI	Trout: Brook	89.665	99.059	101.565	83.477
MF-TEST .DAT	22	0	Total Weight	ALL SPECIES	2238.1	892.8	745.6	599.7
MF-TEST .DAT	22	1	Total Weight	Trout: Rainbow	564.8	188.0	183.5	193.3
MF-TEST .DAT	22	2	Total Weight	Trout: Brook	1326.8	474.3	526.9	325.6

APPENDIX 3: (Con.)

MF-TEST .DAT 22 3 Total Weight	Sucker	346.5	230.5	35.2	80.8
MF-TEST .DAT 23 0 Wt % -- Spec	ALL SPECIES	100.0	39.9	33.3	26.8
MF-TEST .DAT 23 1 Wt % -- Spec	Trout: Rainbow	100.0	33.3	32.5	34.2
MF-TEST .DAT 23 2 Wt % -- Spec	Trout: Brook	100.0	35.7	39.7	24.5
MF-TEST .DAT 23 3 Wt % -- Spec	Sucker	100.0	66.5	10.2	23.3
MF-TEST .DAT 24 0 Wt % -- Site	ALL SPECIES	100.0	100.0	100.0	100.0
MF-TEST .DAT 24 1 Wt % -- Site	Trout: Rainbow	25.2	21.1	24.6	32.2
MF-TEST .DAT 24 2 Wt % -- Site	Trout: Brook	59.3	53.1	70.7	54.3
MF-TEST .DAT 24 3 Wt % -- Site	Sucker	15.5	25.8	4.7	13.5
MF-TEST .DAT 25 0 Avg Weight	ALL SPECIES	8.1	7.5	11.8	6.3
MF-TEST .DAT 25 1 Avg Weight	Trout: Rainbow	9.1	9.0	13.1	7.2
MF-TEST .DAT 25 2 Avg Weight	Trout: Brook	11.4	12.5	13.9	8.1
MF-TEST .DAT 25 3 Avg Weight	Sucker	6.0	6.1	5.0	6.2
MF-TEST .DAT 26 1 Wt Std Dev	Trout: Rainbow	11.790	9.126	16.036	10.996
MF-TEST .DAT 26 2 Wt Std Dev	Trout: Brook	15.801	13.525	17.416	16.030
MF-TEST .DAT 27 1 Wt Lower CI	Trout: Rainbow	6.1	4.8	3.8	2.8
MF-TEST .DAT 27 2 Wt Lower CI	Trout: Brook	8.5	8.0	8.1	3.0
MF-TEST .DAT 28 1 Wt Upper CI	Trout: Rainbow	12.1	13.1	22.4	11.5
MF-TEST .DAT 28 2 Wt Upper CI	Trout: Brook	14.3	16.9	19.6	13.3
MF-TEST .DAT 29 0 Est Biomass	ALL SPECIES	2350.1	926.4	787.2	636.5
MF-TEST .DAT 29 1 Est Biomass	Trout: Rainbow	588.1	197.0	183.5	207.6
MF-TEST .DAT 29 2 Est Biomass	Trout: Brook	1397.2	486.8	568.5	341.9
MF-TEST .DAT 29 3 Est Biomass	Sucker	364.8	242.6	35.2	87.0
MF-TEST .DAT 30 0 Est Bio % Sp	ALL SPECIES	100.0	39.4	33.5	27.1
MF-TEST .DAT 30 1 Est Bio % Sp	Trout: Rainbow	100.0	33.5	31.2	35.3
MF-TEST .DAT 30 2 Est Bio % Sp	Trout: Brook	100.0	34.8	40.7	24.5
MF-TEST .DAT 30 3 Est Bio % Sp	Sucker	100.0	66.5	9.6	23.8
MF-TEST .DAT 31 0 Est Bio % Si	ALL SPECIES	100.0	100.0	100.0	100.0
MF-TEST .DAT 31 1 Est Bio % Si	Trout: Rainbow	25.0	21.3	23.3	32.6
MF-TEST .DAT 31 2 Est Bio % Si	Trout: Brook	59.5	52.5	72.2	53.7
MF-TEST .DAT 31 3 Est Bio % Si	Sucker	15.5	26.2	4.5	13.7

APPENDIX 4: SAMPLE DATA (MF-TEST.DAT)

```
MICROFISH TEST DATA
1   1   3   161   42.5
1   1   2   118   17
1   1   2   104   16.9
1   1   3   119   27
1   1   3   130   30.9
1   1   2    98   17.2
1   1   2   118   22.2
1   1   3   100   15.1
1   1  10     .     .     11     68.2
1   1  11     .     .      7        .
1   2   3   110   18.2
1   2   3   129   29.2
1   2   2   110   19.4
1   2  10     .     .     11     58.3
1   2  11     .     .      7        .
1   3   3   102   16.5
1   3   3   119   26.5
1   4   3   130   29.8
1   1   3   164   49.5
1   1   2   133   31.2
1   1   3   114   16
1   1   2    96   10.9
1   1   3    68    3.5
1   1   3    77    6
1   1   3    78    3.5
1   1   2    79    4.6
1   1   3    69    4.1
1   1   3    52    1.6
1   1   3    46    1.2
1   1   2    45    1.5
1   1   3    60    3.4
1   1  10     .     .      8     49.6
1   1  11     .     .      3        .
1   2   2    57    2.1
1   3   3    95    9.2
1   4   2   101   10.1
1   4   3    69    3.5
1   1   3   121   19.2
1   1   3   155   36.6
1   1   2   118   18.6
1   1   3    57    3.4
1   1   3   110   15.2
1   1   2    60    4.1
1   1   3    72    6.4
1   1   3    71    5.9
1   1   3    55    4.4
1   1   3    67    2.4
1   1   2    41    2.5
1   1   3    60    1.2
1   1  11     .     .      2        .
1   2   3   139   30.8
1   2   2    62    2.8
1   2   3    38     .5
```

APPENDIX 4: (Con.)

1	2	3	68	3.9		
1	2	2	55	2.3		
1	2	3	47	1.5		
1	2	2	39	.5		
1	2	3	35	.5		
1	3	3	43	.7		
1	3	2	50	.9		
1	3	3	47	.9		
1	3	2	43	.5		
1	3	3	62	1.6		
1	3	2	46	1.3		
1	3	10	.	.	6	42.6
1	3	11	.	.	3	.
1	4	2	63	1.4		
1	4	3	68	2		
1	4	10	.	.	2	11.8
2	1	3	190	94.9		
2	1	3	157	49.4		
2	1	2	101	12.8		
2	1	3	118	18.5		
2	1	3	132	25.4		
2	1	3	109	16.8		
2	1	2	71	5.1		
2	1	3	50	3.1		
2	1	3	61	5		
2	1	3	50	3.2		
2	1	10	.	.	4	19.6
2	1	11	.	.	4	.
2	2	3	56	3.7		
2	2	2	52	2.3		
2	2	3	99	11.5		
2	2	3	59	2.8		
2	2	2	37	.5		
2	2	3	66	3.9		
2	2	10	.	.	2	10.8
2	3	3	51	1.5		
2	3	3	44	1.4		
2	3	3	64	3.5		
2	4	2	60	1.7		
2	4	3	62	2.1		
2	4	10	.	.	1	4.8
2	1	3	109	15		
2	1	2	47	1.1		
2	1	3	55	1.3		
2	2	3	101	11.1		
2	2	3	55	.9		
2	2	2	50	.5		
2	2	3	65	2.2		
2	2	3	71	4.4		
2	3	2	57	.8		
2	3	3	72	2.4		
2	3	3	61	4.0		
2	4	3	99	10.8		
2	1	2	161	42.5		

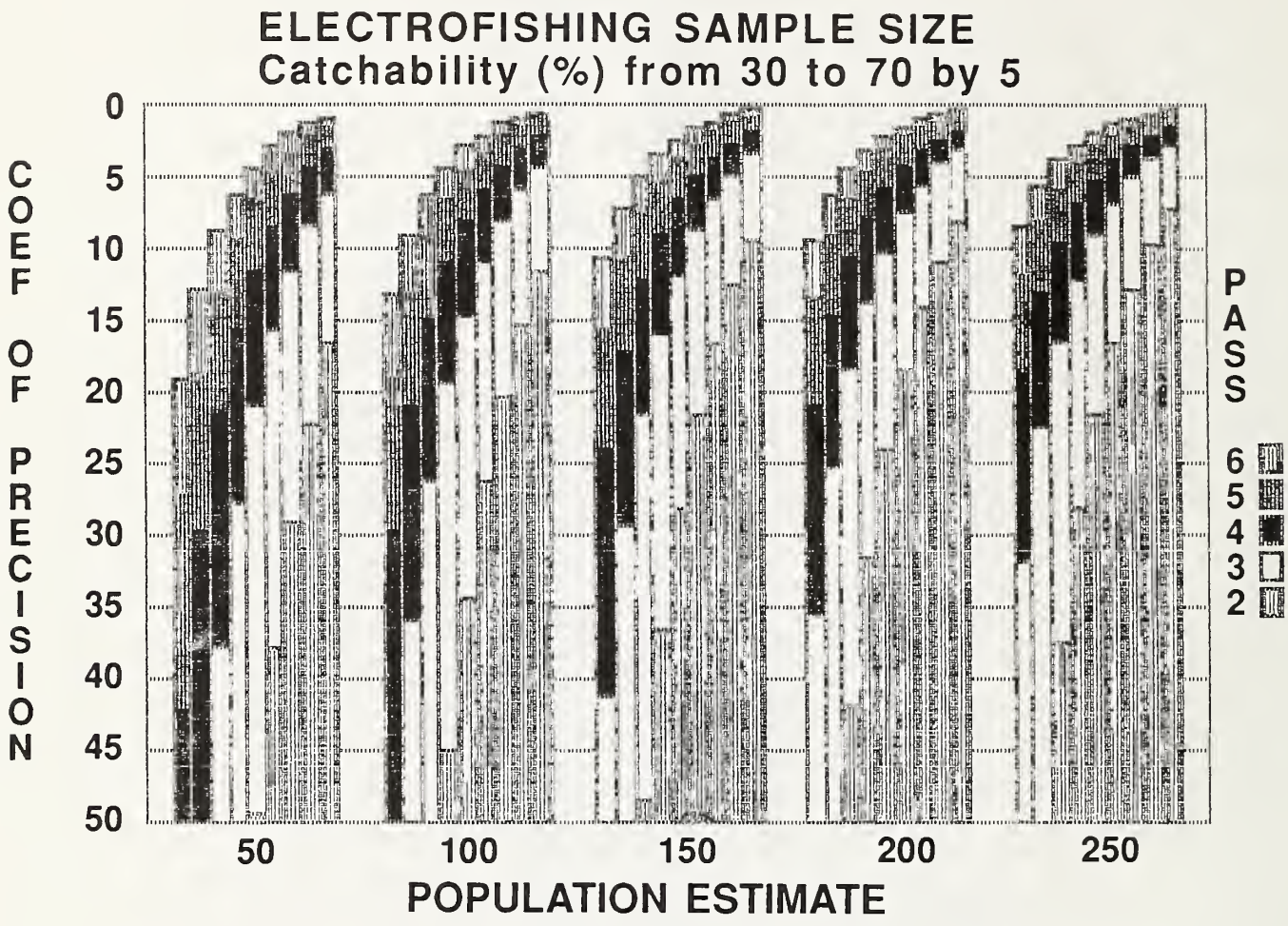
APPENDIX 4: (Con.)

2	1	3	118	17		
2	1	3	104	16.9		
2	1	2	119	27		
2	1	3	130	30.9		
2	1	3	98	17.2		
2	1	3	118	22.2		
2	1	3	100	15.1		
2	2	2	110	18.2		
2	2	3	129	29.2		
2	2	3	110	19.4		
2	3	2	90	10.6		
2	1	2	164	49.5		
2	1	3	133	31.2		
2	1	3	114	16		
2	2	2	96	10.9		
2	2	3	68	3.5		
2	3	3	77	6		
2	4	3	78	3.5		
3	1	3	79	4.6		
3	1	2	69	4.1		
3	1	3	52	1.6		
3	1	3	46	1.2		
3	1	3	45	1.5		
3	1	2	60	3.4		
3	1	10	.	.	6	37.2
3	1	11	.	.	3	.
3	2	2	57	2.1		
3	3	2	95	9.2		
3	4	3	101	10.1		
3	4	3	69	3.5		
3	1	2	121	19.2		
3	1	3	155	36.6		
3	1	3	118	18.6		
3	1	3	57	3.4		
3	1	3	110	15.2		
3	1	2	60	4.1		
3	1	3	72	6.4		
3	1	2	71	5.9		
3	1	3	55	4.4		
3	1	3	67	2.4		
3	1	2	41	2.5		
3	1	3	60	1.2		
3	2	2	139	30.8		
3	2	3	62	2.8		
3	2	3	38	.5		
3	2	3	68	3.9		
3	2	2	55	2.3		
3	2	3	47	1.5		
3	2	3	39	.5		
3	2	3	35	.5		
3	2	10	.	.	3	16.8
3	2	11	.	.	2	.
3	3	2	43	.7		
3	3	3	50	.9		

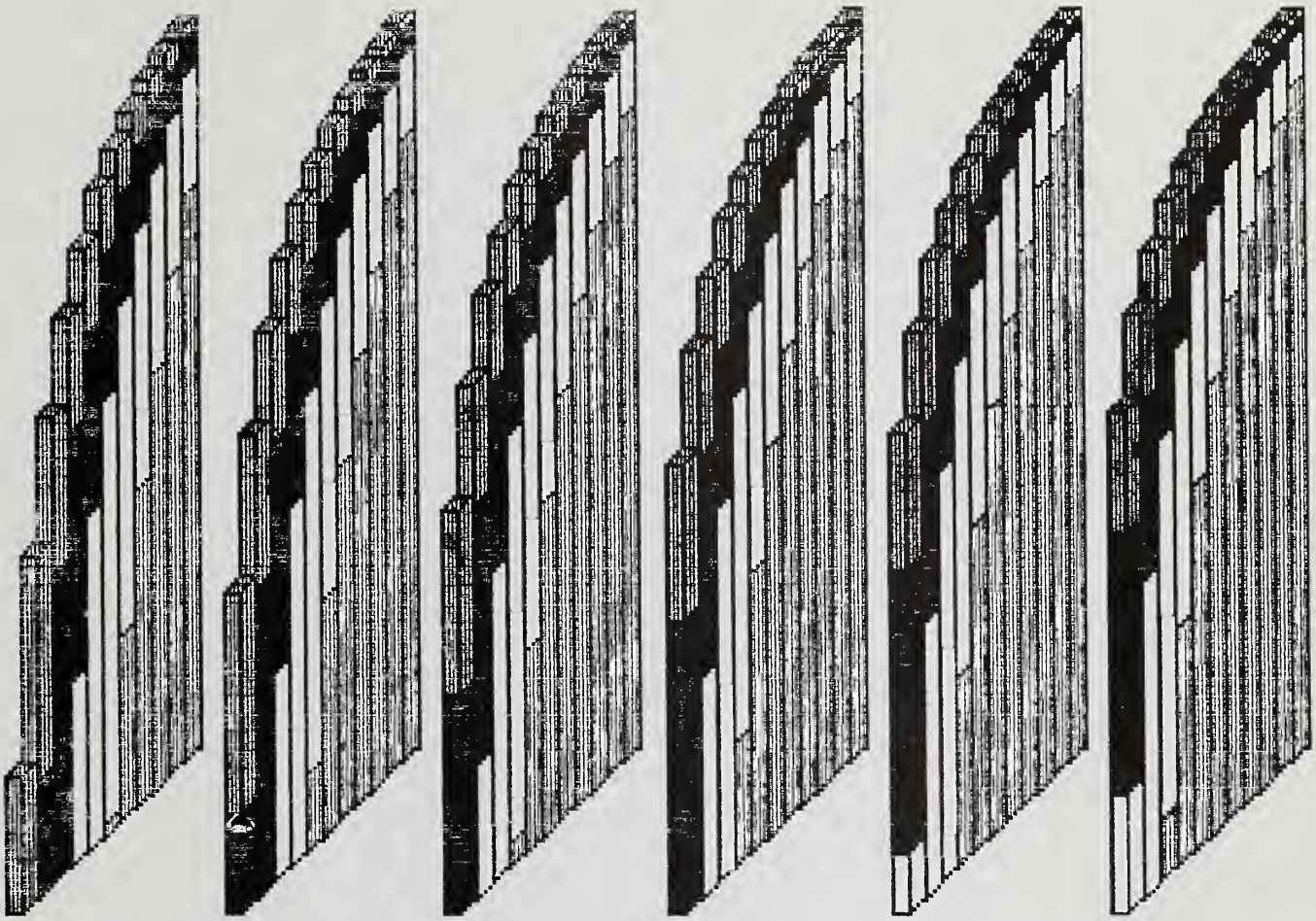
APPENDIX 4: (Con.)

3	3	2	47	.9		
3	3	2	43	.5		
3	3	3	62	1.6		
3	3	3	46	1.3		
3	3	10	.	.	3	21.0
3	3	11	.	.	5	.
3	4	3	63	1.4		
3	4	2	68	2		
3	4	10	.	.	1	5.8
3	4	11	.	.	5	.
3	1	3	190	94.9		
3	1	2	157	49.4		
3	1	3	101	12.8		
3	1	3	118	18.5		
3	1	3	132	25.4		
3	1	2	109	16.8		
3	1	3	71	5.1		
3	1	2	50	3.1		
3	1	2	61	5		
3	1	3	50	3.2		
3	1	3	56	3.7		
3	1	2	52	2.3		
3	2	3	99	11.5		
3	2	2	59	2.8		
3	2	3	37	.5		
3	2	3	66	3.9		
3	2	2	51	1.5		
3	3	2	44	1.4		
3	3	3	64	3.5		
3	4	2	60	1.7		
3	1	2	109	15		
3	1	3	47	1.1		
3	1	2	55	1.3		
3	2	3	101	11.1		
3	2	2	55	.9		
3	2	3	50	.5		
3	2	3	65	2.2		
3	2	2	71	4.4		
3	4	3	62	2.1		

APPENDIX 5: OUTPUT EXAMPLE FROM THE MICROFISH SAMPLE SIZE PROGRAM (2-D), (MF-SS2D.EXE)



APPENDIX 6: OUTPUT EXAMPLE FROM THE MICROFISH SAMPLE SIZE PROGRAM (3-D), (MF-SS3D-EXE)



☆U.S. GOVERNMENT PRINTING OFFICE: 1989-673-039/81007

Van Deventer, John A.; Platts, William S. 1989. Microcomputer software system for generating population statistics from electrofishing data—user's guide for **MicroFish 3.0**. Gen. Tech. Rep. INT-254. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 29 p.

MicroFish (version **3.0**) is a microcomputer software system designed for calculating fisheries population statistics from electrofishing data. System output includes maximum-likelihood population estimates, total catches, capture probabilities, removal patterns, lengths, weights, condition factors, and biomass. Relative percentages, standard errors, and confidence intervals are generated for each sampling site and species in the data set. Output options enable the user to create tables or database files which can be used as input for statistical, spreadsheet, or graphics packages. Sample size programs display two- and three-dimensional color graphs for predicting the number of electrofishing passes needed to achieve a desired precision level in the population estimate.

KEYWORDS: computer, information systems, fisheries management, population estimate, biomass

INTERMOUNTAIN RESEARCH STATION

The Intermountain Research Station provides scientific knowledge and technology to improve management, protection, and use of the forests and rangelands of the Intermountain West. Research is designed to meet the needs of National Forest managers, Federal and State agencies, industry, academic institutions, public and private organizations, and individuals. Results of research are made available through publications, symposia, workshops, training sessions, and personal contacts.

The Intermountain Research Station territory includes Montana, Idaho, Utah, Nevada, and western Wyoming. Eighty-five percent of the lands in the Station area, about 231 million acres, are classified as forest or rangeland. They include grasslands, deserts, shrublands, alpine areas, and forests. They provide fiber for forest industries, minerals and fossil fuels for energy and industrial development, water for domestic and industrial consumption, forage for livestock and wildlife, and recreation opportunities for millions of visitors.

Several Station units conduct research in additional western States, or have missions that are national or international in scope.

Station laboratories are located in:

Boise, Idaho

Bozeman, Montana (in cooperation with Montana State University)

Logan, Utah (in cooperation with Utah State University)

Missoula, Montana (in cooperation with the University of Montana)

Moscow, Idaho (in cooperation with the University of Idaho)

Ogden, Utah

Provo, Utah (in cooperation with Brigham Young University)

Reno, Nevada (in cooperation with the University of Nevada)